FY 2020 Annual Report of Accomplishments and Results

Rhode Island
University of Rhode Island

I. Report Overview

The NIFA reviewer will refer to the executive summary submitted in your FY 2020 Plan of Work located in the Institutional Profile. Use this space to provide updates if needed.

1. Executive Summary (Optional)

As recommended by last year's reviewer, we have added strategic goals for research and Cooperative Extension to the Executive Summary. The goals were taken from the 2018-2023 URI College of the Environment and Life Sciences Strategic Plan.

II. Merit and Scientific Peer Review Processes

The NIFA reviewer will refer to your 2020 Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Process	Updates ONLY
1. The Merit Review Process	As recommended by last year's reviewer, more information has been provided about our review process.
2. The Scientific Peer Review Process	

III. Stakeholder Input

The NIFA reviewer will refer to your 2020 Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Stakeholder Input Aspects	Updates ONLY
1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation	As recommended by last year's reviewer, additional information has been provided about who we consider to be stakeholders and how we work with them.
2. Methods to identify individuals and groups and brief explanation.	
3. Methods for collecting stakeholder input and brief explanation.	
4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.	

IV. Critical Issues Table of Contents

No.	Critical Issues in order of appearance in Table V. Activities and Accomplishments
1.	Agriculture and Food Systems
2.	Human and Environmental Health
3.	Local to Global Environmental Change
4.	Youth, Family & Community Development
5.	
6.	
7.	

V. Activities and Accomplishments

Please provide information for activities that represent the best work of your institution(s). In your outcome or impact statement, please include the following elements (in any order): 1) the issue and its significance (e.g. who cares and why); 2) a brief description of key activities undertaken to achieve the goals and objectives; 3) changes in knowledge, behavior, or condition resulting from the project or program's activities; 4) who benefited and how. Please weave supporting data into the narrative.

No.	Project or Program Title	Outcome/Impact Statement	Critical Issue Name or No.
1.	**Improving Control of Gastrointestinal Parasites in Livestock**	Gastrointestinal nematodes (GIN) are associated with increased mortality and reduced performance of sheep and goats in pasture-based operations. These parasites disproportionately impact young animals with immature immune systems. The most pathogenic of these GIN is *Haemonchus contortus*, more commonly referred to as the barber pole worm, for its distinct striped appearance. Sheep and goat producers struggle to control GIN in their young animals because of increasing parasite resistance to commercial de-wormers coupled with a lack of effective alternatives. The discovery that plant secondary compounds, including condensed tannins, suppress GIN infection has provided promise for alternative methods of	Agriculture and Food Systems

		GIN control in sheep and goats. This project evaluated the effectiveness of two plant species containing condensed tannins—the forage birdsfoot trefoil (BFT) and cranberry vine (CV)--for anti-parasitic effects against various life stages of barber pole worm. We screened 51 strains of BFT for their ability to inhibit hatching of barber pole worm eggs, and further evaluated the top-performing 13 BFT strains for motility and infectivity of barber pole worm larvae. Across the 13 strains tested, we found efficacy ranging from 17-93% motility inhibition and 0-75% ex-sheathment inhibition (an indicator of infectivity) at the highest concentration of BFT extracts. We also utilized in vitro and in vivo methods to investigate the antiparasitic efficacy of cranberry vine (CV) extracts against various life stages of the barber pole worm. Lambs fed 500 grams/day of CV had lower fecal egg count than control lambs during the first two weeks of the study. Their fecal egg counts stayed suppressed during weeks one through five, during which time control lambs and those fed 250 grams/day were increasing. Although these studies indicate that CV has anti-parasitic potential against the barber pole worm, further studies are needed to determine proper dosage requirements as well as the optimal feeding time to maximize the effects. Results from these studies have provided further evidence of the anti-parasitic properties of condensed tannin containing forages such as BFT as well as plants such as cranberry vine. It is also evident from our findings that plant secondary compounds play a key role in the observed anti-parasitic effect and that condensed tannins are not the sole factor determining efficacy against barber pole worm infections. Further studies identifying the strains of BFT that confer the highest anti-parasitic activity will provide a valuable tool for sheep and goat producers raising animals on pasture. Furthermore, the development of a cranberry vine supplement that may have utility against GIN infections in lambs is a promising development in the search for alternative strategies to reduce the effects of GIN parasitism in sheep and goats. We have shared the findings of this study with producers by conducting face-to-face workshops (prior to the COVID-19 pandemic) and online training in integrated parasite control best management practices. Additionally, numerous workshops were conducted in conjunction with the National Sheep Improvement Program (NSIP, nsip.org) to educate interested producers on the use of estimated breeding values to balance parasite resistance with other important production	

		traits. Results have been disseminated at national and international meetings. Extension outreach has been conducted with sheep and goat producers, professionals and organizations through electronic listservs and newsletters, the Project Facebook page and website (widely shared), and through distribution of project post cards prior to COVID-19. For the length of the project, the project website had 33,628 unique visitors with 28,115 (84%) from the U.S Students training was an important part of this study. Undergraduate students were trained in research procedures and one undergraduate student presented their research at a national meeting. Graduate students were trained in study design and research procedures and presented their research at national and international meetings.	
2.	**Vegetable Variety Trials Improve Food Security in Rhode Island**	Vegetable seed companies are always introducing new varieties and removing existing varieties from the market. In the vegetable seed industry 10 to 20% of the customers buy 80% of the seed. These customers are large acreage growers in major production areas such as western New York, Florida, Michigan and California, or even growers in Europe and the Middle East. The needs of these growers largely determine which varieties are available. Farmers in Rhode Island and southern New England do not have vegetable varieties developed specifically for their needs; they must choose the best available fit from what is of interest globally. However, farmers have limited space and time to trial new varieties. New varieties carry risk of failure, resulting in lost revenues and unhappy customers. Farmers need information on variety performance under RI conditions to make informed decisions. The Vegetable Variety Trial allows URI to generate that information and provide it to farmers so that they can minimize the risk and maximize the benefits from changing varieties. Variety trials also provide information to the regional seed retailers that they can use to decide which varieties to carry and to advise customers. While the primary audience for the vegetable variety trials is commercial growers, home gardeners can also benefit from knowing which varieties do best in Rhode Island. In FY2020, we trialed 20 muskmelon varieties, 17 broccoli varieties, 9 Swiss chard varieties, and 16 beet varieties. The beet and chard trials failed due to adverse weather. The melon and broccoli trials were successful; trial reports have been submitted to seed company partners and posted to Digital Commons	Agriculture and Food Systems

		https://digitalcommons.uri.edu/riaes_bulletin/. The vegetable variety trials were featured in a virtual farm visit video https://youtu.be/RWudFK2aqfw created by Andy Radin of the Vegetable Extension Program. Due to pandemic restrictions we were not able to share trial results at an in-person field day event. In 2020 five seed companies participated in the variety trials. The most recent data available show trial reports from 2019 were downloaded 202 times in 2020 and there were over 2600 downloads in 2020 across the entire collection of trial reports. In addition to providing information to seed companies and commercial growers, the Vegetable Variety Trial program provided experiential learning opportunities to seven URI undergraduate students. We donated over 2000 pounds of muskmelon and 20 bushels of broccoli to the Rhode Island Food Bank and delivered additional muskmelons, broccoli and swiss chard to food pantries in South Kingstown.	
3.	**URI Master Gardener Program Strengthens Rhode Island's Food System**	Demand for locally grown food has increased in recent years due to consumers' interest in where and how their food is grown and raised. Food Solutions New England set a goal for New England to produce at least 50% of its food by the year 2060, with the state of Rhode Island adopting this goal. During the pandemic, food insecurity rose with a 25% increase in demand at food pantries and 1 in 4 residents experiencing food insecurity. Additionally, disruptions to the global food supply chain related to COVID-19 underscored the importance of supporting locally grown food. By teaching Rhode Islanders to grow a portion of their own food and encouraging consumers to buy locally grown food, URI Master Gardeners are contributing to the 50 by 60 goal and increasing the region's food sovereignty. The program's target audience is Rhode Island residents, as everyone participates in the food system as well as school community members on their school garden team. Residents benefitted by learning to grow their own food and to garden using environmentally sound research-based practices. 11,398 people learned about research-based gardening methods or received technical gardening assistance. After participation, 87% of those surveyed learned something new, and 93% planned to change their behavior. 52% of those surveyed after participation plan to begin growing food for personal/family consumption or change the way they do so after learning from a URI Master Gardener.	Agriculture and Food Systems

		Rhode Islanders were provided with 97,543 pounds of healthy, locally grown produce donated to hunger relief agencies due to URI Master Gardener efforts. This is a 200% increase from the amount of food donated in 2019. These fruits and vegetables were grown in demonstration gardens tended by volunteers, in volunteers' home gardens through the "plant a row" program, which saw a 75% increase in output in 2020, in school gardens for donation, and gleaned from food grown on farms that would otherwise have gone to waste through a partnership with Hope's Harvest RI. Finally, about 50 schools received assistance from URI Master Gardener School Garden Mentors in the form of technical guidance. Eight schools received fall cleanup assistance and Master Gardeners supported the donation of 3,454 lbs. of vegetables donated by school gardens. 2,821 people learned from the school gardens including 2,403 children and 418 adults. While in-person programming was disallowed due to COVID-19, the URIMGP and Cooperative Extension switched to delivering educational lectures virtually through the Learn at Home Webinar series. Topics taught by URI Master Gardener volunteers included planning a vegetable garden, food safety, container gardening, putting the garden to bed, tomatoes, composting, tools and more. Extension experts and community partners offered complementary topics on gleaning, food preservation, composting, family-friendly fruit and vegetable recipes, and fruits for Rhode Island. Additionally, URI Master Gardener volunteers continued to teach virtual workshops hosted by partner organizations such as libraries, universities, churches, and other community organizations through the public presentation program. The gardening hotline and contactless soil testing service provided technical guidance to gardeners looking to adopt research-based gardening practices, diagnose their plant problems or improve their soil. Many clients this year were self-proclaimed beginning gardeners. As a result of URIMGP efforts, more Rhode Islanders experiencing food insecurity had access to healthy, locally grown food. More people began growing food for themselves and their families, or improving their food growing efforts by learning about research-based gardening practices. Hunger relief agencies had more access to locally grown food as the pandemic increased food insecurity statewide as people learned from URI Master Gardeners and grew food for donation or participated in gleaning efforts to harvest food for donation from farms that would have otherwise gone to waste. More people also began	

		composting or increased their efforts, thereby diverting food waste and other materials from the landfill to create a valuable soil amendment. The behavior change goal of the URIMGP is to encourage Rhode Islanders to (1) grow or increase the amount of food for personal/family consumption (2) compost food scraps and/or yard waste (3) grow food for donation to local food pantries and (4) participate in food recovery (a.k.a. gleaning activities on farms where leftover food is donated to hunger relief agencies. Additional metrics tracked include the number of people learning from URIMGP activities and the pounds of food donated to hunger relief agencies due to URIMGP efforts. After learning from URI Master Gardeners and Extension faculty/staff instructors, 575 people will change the way that they grow their own food, while 518 will continue growing their own food and increasing their efforts. 52% of those surveyed said that they would begin to grow food for personal consumption or change the way they did so after attending a URIMGP program. 273 people will begin to grow food/increase the food grown for personal/family consumption for the first time. 147 people will begin composting for the first time, 125 will change the way they compost, and 356 will continue composting based on what they learned. 115 people will be inspired to grow food for donation to food pantries for the first time or change the way they do so, while 91 will continue growing food for donation as they have in the past. 95 people will participate in gleaning activities on farms for the first time after learning from URIMGP programming and 45 will continue doing so as they have in the past. As a result of URIMGP activities, 97,534 pounds of food was donated to hunger relief organizations. 11,518 people learned from URI Master Gardener Program activities including workshops, the Core Training and technical assistance provided through the gardening hotline and soil testing services. More information is available at https://web.uri.edu/mastergardener/impact/.	
4.	**Promoting Healthy Weight in Childhood through Positive Relationships, Diet Quality and Physical Activity**	The preschool years are a critical time for shaping food preferences, which in turn, affect dietary behaviors in adults and lifelong risks for cardiovascular disease (CVD). Unfortunately, US children - especially low-income and ethnic minorities - eat too few fruits, vegetables, and whole grains, and too many energy dense snacks and beverages, behaviors associated with increased morbidity from CVD. There is a pressing need for interventions to help parents shape children's dietary behaviors early in life that are convenient for busy,	Human and Environmental Health

		working families and tailored to children's needs. There is also a lack of interventions that fully target the home food environment by focusing on food quality, food preparation, and positive feeding practices. To develop these interventions, it is necessary to better understand barriers and facilitators of parental feeding of preschool aged children. In this study we conducted key informant interviews with WIC participants and completed an environmental assessment of snack foods. *Key Informant Interviews*: A recurrent cross-sectional qualitative approach was used to identify themes from semi-structured interviews with low-income mothers when their infants were 6 and 12 months of age. A purposive sample of mothers (N = 15) was recruited from Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) offices and childcare centers serving low-income families in Rhode Island. Mothers also completed demographic and infant feeding questionnaires. Independent thematic analyses were conducted to identify themes from the 6- and 12-month interviews. Themes from the 6-month interviews for how mothers defined snacks included the following: 1) snacks are consumed between meals; 2) snacks are smaller portions; and 3) snacks are sweet. Themes from the 12-month interviews included 1) snacks are consumed between meals and 2) snacks are smaller portions as well as 3) snacks do not include all food groups. Themes from the 6-month interviews, which focused on the reasons mothers offered snacks, were 1) infants seemed hungry, 2) infants showed interest, and 3) snacks help manage behavior. Themes from 12-month interviews also included 1) snacks help manage behavior, as well as 2) snacks expose infants to different flavors and 3) snacks expose infants to different textures. These findings suggest that snacks are commonly offered during infancy and that mothers define snacks as smaller portions that help with hunger between meals. However, during early infancy mothers describe snacks as sweet, and across infancy report using snacks to manage behavior, underscoring the importance of providing parents with guidance on healthy snacking during the first year of life. *Environmental Assessment of Snack Foods:* A random sample of grocery stores (N = 20) was selected from low-income census tracts. Twelve items were developed for this study to assess the availability and pricing of infant foods (e.g., infant formula, purees) and infant snack foods (e.g., puffs, melts). The Nutrition Environment Measures Survey in Stores (NEMS-S) was used to assess the	

		nutrition environment including the availability, pricing, and quality of healthful foods compared to less healthful foods. Total NEMS-S scores range from -9 to 54 with higher scores indicating more healthful foods. Data were collected by trained research assistants during a 2-week period to limit confounding due to restocking and seasonality. This analysis included descriptive statistics to summarize the infant snack foods and the total nutrition environment. All 20 grocery stores in this sample sold infant foods and 18 stores sold infant snack foods. Availability of infant snack foods varied by store with puffs having the highest availability (n = 18) followed by melts (n = 15), teething cookies (n = 10), and baby yogurt (n = 7). Baby yogurt had the highest average price per serving ($0.72) followed by melts ($0.62), teething cookies ($0.50), and puffs ($0.49). Mean total NEMS-S score for all grocery stores was 27.5 (SD = 4.7). This observational study of the availability, price, and nutritional content of commercial infant foods and snacks in low-income communities, extends the existing literature availability and nutritional content of these foods in the US. Given that infant foods and snacks are widely available in retail food stores, and some infant snacks contain added sugars, it is essential to provide caregivers with guidance on choosing age-appropriate nutrient-dense snacks. In addition, our study suggests that retail food stores in low-income communities, specifically smaller grocery stores, might benefit from programs and policies that encourage the availability of healthful commercial infant foods and snacks to help infants establish healthy food preferences and eating behaviors starting early in life. As part of the intervention, we are working with a community advisory board to disseminate our findings and maintain open communications. Results from interviews and environmental assessments have been primarily disseminated through conferences and papers.	
5.	**Supporting Human Health with Tick-Borne Disease Education**	The TickEncounter Resource Center promotes tick-bite protection and tickborne disease prevention by engaging, educating, and empowering people to act. TickEncounter connects with stakeholders and extends tick control and tick-borne disease prevention research to end-users in an engaging way that empowers them to take appropriate action. The story below illustrates the difference we make for people across the nation.	Human and Environmental Health

		It was another unlikely tick encounter…mid-January in Ossining NY, and despite the unseasonably warm 60-degree Sunday, most people were not thinking about ticks. It was winter, right? She'd gone hiking--who wouldn't--the weather was unusually exceptional. A chance to get out with her toddler and explore her new neighborhood and local park. She had just moved to the 'burbs' from the city and was excited by the possibilities of open spaces. *She found the tick in her armpit on Wednesday and found TickSpotters that night. Even though she had showered each day and was nursing, too, finding this tick and then learning that it had been attached and feeding for 3 days came as a horrific shock. What followed made her livid. A local infectious disease doc agreed that it was a blacklegged tick but didn't recommend testing and had disposed of it. Now she was anxious and scared because she also was two months pregnant. While we're not medical doctors and we don't dispense disease treatment or testing advice, we sometimes have a unique opportunity to show empathy and try to help allay fears. Now, after trading multiple emails with her, we shared this: "try and remain calm; medicine can fix pretty much all that this tick could possibly bring. Just stay alert for signs and symptoms, like a rash and fever."* *The good news is, it seems like we helped! She wrote, "thank you so much for all of this, you have been an amazing resource. I found an infectious disease specialist and will go ahead with a pregnancy-safe antibiotic. I had just moved from NYC and clearly was not prepared for this. Now, thanks to you I will be in the future. I truly appreciate this so very much."* To help raise tick bite protection awareness, we managed the TickEncounter website and its Facebook, Twitter, Instagram, and YouTube social media channels. Several features of our outreach program make it unique and one of the most widely used tick and tickborne disease prevention resources in America. During this reporting period, TickEncounter hosted >1,000,000 user sessions by >900,000 unique users viewing >2.5 million pages. We added 150 posts to our Facebook page that reached >500,000 people and were shared by >5,500. Our Twitter, Instagram and YouTube channels combined for more than 650,000 additional people reached. Our TickSpotters crowdsourced tick survey and riskiness assessment, promoted as our "free & fast portal to a tick expert," received over 8,000 submissions which came from all 50 United States, every Canadian province, several Mexican states, as well as a number of foreign	

		countries. Each submission received an auto-reply message with generic TickSmart tips and next best actions. All those submissions received at least one additional email providing a customized confirmation of the tick identification, riskiness assessment based on geography, stage of development, and state of engorgement. Additionally, these customized responses provided a more tailored best next action response for preventing disease and future tick encounters. We have now serviced almost 80,000 TickSpotters submissions in seven years of operating this popular crowdsourced, citizen-scientist activity. In addition, we conducted numerous TickSmart (10 in-person and 10 on-line lectures) workshops to various stakeholder groups, including schools, public citizen groups, Master Gardeners, and outdoor workers in MA, RI, NH, NY, PA, OH, CA with an estimated direct reach of 1,500 adults and 250 school children. We also had more than 50 direct media contacts, resulting in significant national and local coverage of tick awareness and the need for improving tick literacy.	
6.	**Understanding Socio-Economic Effects of Offshore Wind Farms in Rhode Island**	The wind power sector has experienced exponential growth in the United States in recent years. By 2018, total wind capacity reached 96.5GW, a four-fold increase within only a decade. An average yearly growth rate of 18% in the past decade propelled the country to become the second-largest wind power market in the world, accounting for 16% of global capacity. Although the growth has been driven by onshore wind power capacity alone, the first commercial offshore wind farm was constructed in the Atlantic Ocean, off the coast of Block Island, Rhode Island in 2016. The five-turbine, 30 MW project is 3.8 miles away from the shore and started operating in December 2016. The farm provides most of Block Island's energy demand, which had historically depended on diesel generators. This farm paved the way for proposals of several other offshore wind projects with a combined potential capacity of over 25,000 MW throughout the country. As of June 2018, offshore wind farms with a cumulative capacity of 1,900 MW are approved to commence operations by 2033, with the majority of the share being accounted for by three states: Massachusetts (800 MW), Rhode Island (400 MW), and Connecticut. The purpose of this study was to examine the impact of offshore wind turbines on tourists' preferences while they participate in a suite of recreational activities (sightseeing, fishing, boating, beach visitation, and bird or whale watching). We looked into how (i) prior knowledge and (ii) the sight of the	Local to Global Environmental Change

		turbines affects the revenue generated from tourism. The relationship between tourist activities and offshore turbines has not yet been studied in the context of the establishment of an actual offshore wind farm in the US. We contribute to the literature by exploring how an offshore wind farm affects tourist preferences for the type of recreational activities performed. Specifically, we analyzed the farm's impact on the respondents' willingness to pay (WTP) for these activities in two scenarios: at locations with a view, and without a view of the wind farm. By examining the impact of having seen the turbines on WTP, we also tested whether the tourists at Block Island consider the wind farm to be a visual disamenity, a result which will provide some insight into future offshore wind developments in the US. To meet these objectives, we designed an original survey within the context of the Block Island Wind Farm. The survey asked about recreational activities, trips to Block Island, and a broad range of socioeconomic characteristics. The sample consisted of 263 people who have been to Block Island at least once in the years 2013 - 2018. The focus of the survey was to analyze the impact of the knowledge and sight of the Block Island wind farm on respondents' WTP for choice activities and locations. Across recreational activities, we found that 46-56% of the respondents were indifferent to turbine presence; that is, they were unwilling to pay anything for their choice. Though there is heterogeneity in WTP by activity, the average WTP is positive across all activities. Following the contingent valuation framework, we estimated multiple regression models to understand the determinants of WTP. Our results indicate that respondents with prior knowledge of the turbines are willing to pay $34 more, on average, for beach locations with a view of the turbines. We found that seeing the turbines in person during the trip had a positive impact on the WTP for fishing and boating, with respondents willing to pay on average, $9.47 more for fishing locations and $20.91 for boating routes with a view of the turbines. This result suggests that the turbines are visually pleasing to people engaged in fishing and boating activities at Block Island, a finding that is contrary to the conclusions of Ladenburg & Dubgaard, (2009). We also found limited evidence of differences in WTP by partisanship: there was no difference in the WTP between Republicans and Democrats for any activity. Independents, however, are willing to pay less for boating and bird/whale watching locations that have a view of the turbines. Socio-economic factors have a weak impact on the WTP, while environmental attitudes have no	

		association with the respondents' WTP for choice activities at locations with a view of the turbines.	
7.	**Host Plant Resistance as a Tool for Eastern Hemlock Restoration**	This study addresses the potential for resistance in eastern hemlock to the invasive hemlock woolly adelgid (HWA), an insect that has decimated eastern and Carolina hemlocks on the East Coast of the US. It combines field research assessing plant responses to the insect with laboratory research dedicated to developing a series of assays useful to quickly determining whether individual trees have resistance to this insect. The project has four research objectives: 1) Identifying, propagating, and assessing host resistance in PA hemlocks; 2) Monitoring resistant hemlock outplantings in PA; 3) Assay for HWA response to feeding on resistant versus susceptible hemlocks; 4) Assay for response of hemlock plant-defense systems to HWA feeding; and 5) Assay development for elicitors of HWA-like responses in hemlock. Progress on objectives 1, 2, and 4 are described below. Objective #1: We conducted detailed surveys of hemlocks in over 70 sites in PA and western NJ that foresters and land managers identified as possibly containing adelgid-resistant hemlocks. In each case, we rated tree health and used that to classify each site according to its likelihood of containing adelgid-resistant trees. For the most likely sites, we used current and historical satellite imaging to examine changes in hemlock cover over several decades to confirm that the surviving trees had once been part of much larger hemlock stands. Most surveys were conducted in fall 2017 and 2018, with a few in summer 2019 and the last ones in fall 2019. In January 2020, we met with several PA DCNR State Foresters and provided them with the coordinates and our assessment of each site. They are extremely excited about the potential for reforestation efforts using adelgid-resistant eastern hemlocks, and they've indicated that they'll be taking cuttings from the most promising trees for use in large-scale propagation work. Objective #2: In 2018 and 2019 we assessed the success of a pilot reforestation project comparing the survival and vigor of adelgid-resistant and adelgid-susceptible eastern hemlocks planted at various field sites. The reforestation project started in 2015 and took place at sites in PA and seven other eastern US states. At each site, eight adelgid-resistant and four adelgid-susceptible trees were planted in the understory of adelgid-devastated hemlock	Local to Global Environmental Change

		forests. The trees were held inside fenced plots to protect against deer browse, but otherwise exposed to adelgids and other herbivores. A graduate student revisited the plots in fall 2018 and spring 2019 and surveyed each of them for tree survival, vigor, and pest densities. He found that resistant trees survived better and were more vigorous than their adelgid-susceptible counterparts. Because adelgid densities declined regionally during this period, he was unable to assess whether the resistant trees supported lower adelgid densities. In the spring 2019 survey, however, he found that adelgid-resistant hemlocks had lower densities of elongate hemlock scale, another major invasive pest of eastern hemlocks. He presented these results at three regional meetings, the 2019 US Forest Service Hemlock Woolly Adelgid Forest Manager's Meeting, and the January 2020 USFS Meeting on Forest Pests in Annapolis MD. His paper on this work, published earlier this year in the journal 'Forests,' attracted considerable attention and appears to have sparked widespread interest in the use of the adelgid-resistant trees in reforestation efforts. Objective #4: We have found that infestation with HWA improves attraction and performance of folivorous insects on hemlock. This increased performance may be mediated by HWA feeding causing antagonism between the jasmonic acid and other hormone pathways. We conducted a common garden experiment that crossed HWA infestation with artificial plant defense induction using methyl jasmonate (MeJA), then measured secondary metabolite contents and defense-associated enzyme activities in order to explore how HWA feeding affected the local and systemic induction of JA-elicited defenses. We found that in local tissue HWA or MeJA exposure resulted in unique induced phenotypes, while the combined treatment resulted in an induced phenotype that was a mixture of the two individual treatments. We also found that if the plant was infested with HWA, the systemic response of the plant was dominated by HWA, regardless of whether MeJA was applied or not. Interestingly, in the absence of HWA, hemlock plants had a very weak systemic response to MeJA. We conclude that HWA infestation prevents systemic induction of JA-elicited defenses. Taken together, compromised local JA-elicited defenses combined with weak systemic induction could be major contributors to increased folivore performance on HWA-infested hemlock. The results of this study have been disseminated via articles in peer-reviewed journals, multiple invited presentations, and individual discussions with forest managers at meetings.	

8.	**Protecting Public and Environmental Health Through Improved Septic Systems**	Onsite wastewater treatment systems (OWTS; also called septic systems) are used in unsewered areas to treat human wastewater and recycle water via groundwater recharge. They also help to maintain riparian, wetland, and aquatic ecosystems. In most cases conventional OWTS, consisting of a septic tank and gravity drain field, work well for protecting public and environmental health. However, conventional OWTS do not remove nitrogen (N) from wastewater and in coastal ecosystems contribute to eutrophication of marine systems due to N inputs in poorly flushed marine systems. Eutrophication of marine waters negatively impacts recreation, tourism, fishing and shell fishing, and property values. Contamination of local groundwater resources with N from septic systems poses health risks to human populations and costs residents and communities millions of dollars in additional treatment required to achieve potable water. In Rhode Island entire watersheds require mandatory advanced N removal OWTS technologies be used to protect public and environmental health. Advanced N reducing OWTS have been developed to specifically target N removal from wastewater and to assure sustainable development in N sensitive areas. In the Northeast US the wastewater professionals engaged in siting, design, permitting, installation, and operation and maintenance of these and other OWTS are required to earn continuing education credits to renew their professional licenses. Since 1993, the New England Onsite Wastewater Training Program and the Laboratory of Soil Ecology and Microbiology at URI have provided research-based outreach education and training opportunities to undergraduate and graduate students and onsite wastewater practitioners in the region. We provide student teaching and experiential learning opportunities to students and conduct industry specific research under our URI AES mission and we incorporate our research findings into outreach education classes for our practitioner communities. The New England Onsite Wastewater Training Program works with a diverse set of stakeholders and clientele, including homeowners, professionals in the onsite wastewater treatment (i.e. septic system) industry, municipal and regulatory officials associated with onsite wastewater management and	Local to Global Environmental Change

		regulation, as well as other researchers and scientists in the northeast USA and across the globe working with onsite wastewater. We are one of the leading land grant institutions dealing with OWTS science in the USA, and in a typical year our outreach classes reach around 500 people. Our before and after class evaluations indicate an increase in knowledge gained and attendees give our program high marks for content and information to help benefit their activities and businesses. Four of our classes help our clientele to gain other registrations/licenses that leads to new professional business opportunities. Our decades long research and outreach approach has helped to incrementally changed the OWTS landscape in RI and neighboring states in the region, creating new learning, occupation, and business growth opportunities for our students and practitioner stakeholders. We have created new technologies that have fostered sustainable development in our region while also protecting public and environmental health. These include promotion of tested and proven alternative OWTS, advanced N reduction technologies, invention of bottomless sand filters (a widely-utilized drain field technology), development of non-proprietary layered soil treatment areas, development of affordable and easily implemented in-field testing methods to verify real time treatment performance of N reduction technologies, training and registration of over 600 septic system inspectors in Southern New England, and promotion of the use of pressurized drain fields so that today they are a routinely-used technology. In 1993, very few alternative OWTS technologies were being used. Over an eight-year period, the URI NEOWT Program was instrumental in conducting state and federally funded proof of concept studies designing, installing and evaluating the treatment performance of 60 alternative technologies. The findings from these studies were presented to RI Department of Environmental Management (RIDEM) for regulatory action and at the same time we trained our private sector clientele about design, installation and operation and maintenance requirements for these systems. Incrementally, more widespread utilization of these new technologies has occurred because of URI activities. Today, approximately 30 percent of all OWTS applications to RIDEM are for advanced treatment OWTS. According to state officials, approximately one bottomless sand filter (a generic technology developed by NEOWTP) application is approved by RIDEM each day, which helps achieve sustainable development and protection of public and environmental health in RI and elsewhere in the region.	

		In this reporting period, and despite of Covid-19 restrictions, we reported our research results in 10 peer reviewed journal publications, 3 PhD dissertations, 16 professional presentations, and 17 outreach classes (which reached 225 class attendees). For more information, please see https://web.uri.edu/owt/ and https://sites.google.com/site/soilecologyandmicrobiology/home	
9.	**URI Energy Fellows Program Grows Rhode Island's Sustainable Energy Workforce**	Energy generation, conservation, siting, and cost are critical issues in Rhode Island and the nation. Our energy systems are undergoing rapid and transformational changes and there is a need for a professional energy workforce that understands the environmental, economic, and societal risks and opportunities created by these changes. Challenges include but are not limited to climate change and environmental degradation, siting and integration of renewable energy, energy efficiency and conservation, energy equity and environmental justice and workforce development. In response to a growing need for student experiential learning opportunities in energy, URI Cooperative Extension created the Energy Fellows Program in 2008 to engage and train students passionate about a career in sustainable energy. To date, the program has seen over 100 students complete program requirements, with the large majority now working in the energy industry in Rhode Island and beyond. In addition to providing real-world experiential opportunities for students, the Energy Fellows Program serves as the premier talent pipeline for energy companies and organizations for entry- to mid-level professionals with a comprehensive understanding of the rapidly changing energy industry. Each year, the program recruits top energy companies and organizations to mentor URI Energy Fellows, and many of the mentors go on to hire students completing the program. In 2020, 12 students completed their training through the Energy Fellows Program. Students attended 24 hours of industry-led training and virtual site visits and completed six credits of professional development modules. Each student completes a 600+ hour paid internship placement with a company or organization working in sustainable energy. In addition to the experiential learning provided during this internship, students are required to complete extensive professional development and targeted industry training, designed to increase their understanding of the complexities surrounding infrastructure,	Local to Global Environmental Change

		markets, and policies of the energy system. Throughout the year Energy Fellows attend and participate in Extension activities to develop their skills in outreach to stakeholders and the public regarding complex energy issues. After completing the program students have an increased capacity to 1) pursue a career in sustainable energy; 2) understand and critically process real-world energy issues; and 3) extend complex knowledge about the energy system to the public. Two students provide examples of the contribution the Energy Fellows Program provided to the RI clean energy workforce in 2020. Sarah O., a 2019 URI Energy Fellow, was placed with an energy development company because of her interest in renewable energy and business development. Sarah completed the program in December of 2020. Sarah exceled at her placement and was kept on for a full year after her internship. When she decided to move on, Sarah was quickly hired by a solar asset management and operations company in Boston, MA. In the same year, Jamie B. was hired through the Energy Fellows Program for a placement with the RI Office of Energy Resources to assist with workforce development projects there. After completion of the program, Jamie was hired by National Grid as an Associate Consultant for complex distributed energy generation projects. Because of the training provided via the Energy Fellows Program, each of these students developed transferable skills that allowed them to easily secure positions in the clean energy sector not directly related to their internship work. Rhode Island and the New England region gained valuable professionals that understand the interconnectedness and complexity of the energy system.	
10.	**URI 4-H Strengthens Rhode Island's Youth and Families**	The 2019 Annual Prepare RI report cited that in 2019, "...less than 45% of residents have a post-secondary degree or industry-recognized certificate, yet 70% of [RI] jobs will require those credentials by 2020." Many Rhode Island youth are not receiving the resources necessary to transition to productive, successful, happy, contributing young adults. Youth need opportunities to engage in positive out-of-school educational programs to help them gain agency and connection to their community, develop valuable life and career skills, introduce them to career paths and scientific methodology and foster a sense of belonging through relationships with caring adults invested in their future. Youth need a safe and nurturing environment to test their abilities and receive constructive and supportive feedback. Encouragement by caring adults and	Youth, Family & Community Development

		positive peer support enable youth to develop confidence and incorporate these life skills into their school and community. 4-H Positive Youth Development models and the Thrive Model have been integrated into RI 4-H to provide experiences that increase the likelihood of enhanced wellbeing and optimal development of 4-H participants. RI 4-H focuses efforts on science education, personal development and healthy lifestyles programs for youth delivered by caring adult volunteers to help Rhode Island youth thrive and excel. Rhode Island school age youth age 5-18 are the primary audience of the 4-H program, with their families and adult volunteers being secondary audiences. Being a longitudinal program (youth can participate continually from age 5-18) it is often hard to measure the magnitude of the impact prolonged exposure to the 4-H program can have on the trajectory of a young person's life. The best way to illustrate the magnitude of the Rhode Island 4-H program is to let the youth speak for themselves: "4-H has given me so many opportunities to learn, to grow, and to have fun. 4-H is more than an organization, it's a community, a family. My 4-H family has helped me along my journey, and I know that they'll be there for me always. Through 4-H activities and projects, I am able to lead, learn, listen, laugh, and love. I have been able to express myself, give back, and have great experiences to enhance my growth as a person, and a citizen. …. I feel through these projects and activities I have been set up for a promising path in the future. Though it may be fuzzy, the future is bright, and only a strong family can withstand a storm. This storm that is 2020 has not blown us down, and will not, for we as a community, and a family press on. Although I couldn't hug my 4-H family, their love could be felt in their support of my endeavors, and in their bestowing of happy moments."- Clare T, age 13. "Through this year of lost hope, uncertainty, and craziness, the most important takeaway as 2020 wraps up, is community. Through this rollercoaster of a year the number one things that have stayed constant are 4-H and family. Thank you 4-H for never giving up on us kids and thank you to my family for helping me achieve my goals."- Abby F. Age 17 "RI 4-H has done a great job adapting to the circumstances and still making 4H fun. The clubs I participate in like Foodies are still staying connected through zoom. I found that it is really fun to cook through zoom. There were also virtual fairs created, seeing all the art in a virtual gallery was so creative and made it so exciting. There were even still events like rock painting to place in	

		public locations for community service and the short story contest. Even making this record book online! I know I certainly cannot label this 4H as "typical" but even while being socially distanced, 4H still positively impacted my life this year. I was able to improve my little homestead, still submit photography into the fairs, show my goats, learn to cook eggplant parmesan with foodies, and learn about forensics with teen science. Whatever the circumstances were this year, I still found ways to look on the bright side and 4H still made it possible to be a part of the community."- Nadya S. Age 17, "While we have struggled with adjustments and losses in so many ways through COVID, there have been opportunities and blessings. I think without 4H it would have been harder to find these bright spots and there would have probably been fewer. I am thankful for the part of me that 4H helped to create that has given me the love and desire to learn by doing. To use my Head, my Hands, and my Heart in all that I do and be around people that do the same. I have a new understanding on how much all of my 4H family and activities mean to me now."-Caleb C. Age 17 "In the past, I have taken 4-H for granted. It's been a part of my life for as long as I can remember, and my family has partaken in it for at least three generations. So much of my life has been dictated by 4-H, that I didn't know what it was like to have no fairs over the summers and very few events throughout the year. This year changed how I looked at 4-H, as I finally understood what it was like to not have it. It has made me miss the events I've never missed before. 4-H itself has made me a responsible and caring person, who thrives with a sense of community. I wouldn't have realized how much it made me who I am without feeling life without it." - Emma H. Age 15 "I enjoy learning more about animal science and care. I took animal science in school this past year as well and received college credit for the course that will transfer to URI or UCONN when I attend in the future! 4H has driven my interest and love of animals, agriculture and learning more in this area. I am looking forward to finding a fit for me in the field after graduation, maybe in Ag Engineering pairing this with my love of math and science. I attended the 4-H Professional Development Career Symposium where we learned how to present ourselves in a more polished way, helping to get me thinking towards the future. Then the Goat Workshop became such a highlight of the year. We learned parasite ID and prevention info, how to make goat milk soap and showing	

		techniques. I really enjoy learning all of the various breeds and enjoy applying the new stuff that I learn."- Caleb C. age 17 "I was not an active member of my high school's clubs or athletics, but rather found passions on my own, specifically through my experiences in Rhode Island 4-H. Through the introduction of 4-H into my life, I found a talent and skill that I know will follow me my entire life: photography. Where do I even begin with what 4-H has given to me in terms of a lifelong skill? To be honest, it began by speaking with Ms. Heidi and Ms. Kristi about what I could do in 4-H. I started to enter 4-H contests like the Fine Arts Contest, the Washington County Fair contest, workshops and many more. The 4-H art contests really gave me a space where I could showcase my skills without any judgement. I am forever grateful for the way 4-H helped me put myself out there in the art community. If it were not for them, I would not be showcasing my work and having the confidence to do so.- Sophia P. Age 18 "Yeah so it goes without saying that this Covid-19 virus really changed the year for not just me, but everyone. You want fairs? Nope. You want activities? Nope. However… this shouldn't stop us from doing what we as 4-Hers pledge to do. LEARN, BY DOING and we will learn how to adapt to this, by doing what we need to do. So yes we stepped up our game in a way, 4-H taught us how to record and edit ourselves showing our animals. Upload videos and pictures of our work and we fought with computers to get it all to work. We learned skills that we have now had to use in school and for other activities, so 4H AGAIN prepared us for life and let us be ready to teach others and lead through some new and shaky territory even for the adults and teachers in our lives."- Devon C. Age 14 Through a cadre of delivery methods Rhode Island 4-H produced 33 distinct events/programs in 2019-2020 focused on improving academic competencies, introducing youth to career options, and giving youth the skills and opportunity to lead and provide service to their communities. Veterinary Science workshops, horticulture workshops, public speaking and communication programs, monthly teen science career and exploration events, career and professional development events for teens, virtual fairs, contests and challenges, recognition and achievement programs are some examples of the programs produced. Service-learning projects to foster connections to community are built into the RI 4-H programs. RI 4-H Clubs and after-school programs are expected to plan and conduct at least one community service project during the 4-H year as part of the Citizenship mission mandate. 4-H youth are provided with community	

		service opportunities through the 4-H email lists and connected to requests from citizens and community groups requiring assistance. 4-H groups may apply for financial support through the RI 4-H Foundation Club Grant program for their projects. 4-Hers document their individual community service hours through their 4-H Record Books. 4-H members are strongly encouraged to participate in the RI 4-H Public Presentations program and Leadership programs at the club, district, and state level to increase communications and leadership competencies. 4-H volunteers and staff provide training, competitive and noncompetitive speaking opportunities for 4-H youth of all ages. Our nature environmental challenges, horticulture workshops, veterinary science workshops and teen science nights are designed to increase science competencies, encourage youth to explore questions scientifically and increase their interest in science careers. To support academic competencies for all those in education struggling with distance learning, RI 4-H also launched a website to support homeschoolers, teachers and parents get resources and better understand the RI Department of Education's standards for grade levels. In our current Covid-19 environment viewing change in the 4-H program participants is difficult because we have not been able to be with them in over 7 months. However, the self-reported data and reflections offer some insights. Surveys revealed that 93% of 4-Hers report they will use the information they learned at RI 4-H programs in 2020 when they make decisions in the future and 100% responded that they will apply the skills they learned at these RI 4-H workshops in the future. Youth self-reported that they used the skills and competencies learned in 4-H activities to become leaders during the COVID-19 pandemic, like the following example: "As for volunteer work this 4-H year, I have done a lot. Because of Covid-19, I volunteered at DMAT, the Disaster Medical Assistance Team over the summer. I worked in logistics, mostly cataloguing, and doing manual labor. My brother and I each volunteered over 375 hours and since we started earlier than most, by the end we were being looked to for advice and direction. I found that it didn't bother me at all, thanks to my leadership experience in 4-H. This year I've discovered that I am a leader in and out of 4-H and that even when the world gets in the way, 4-H and more can still happen and I can lead the way!"-Becca K. Age 15 Outputs from federal fiscal 2020 include the following: Rhode Island 4-H managed 3 email lists, 1 newsletter, 3 websites, 1 Facebook page, 1 Instagram	

		page, a YouTube Channel and produced 33 distinct events/programs in 2019-2020 focused on improving academic competencies, introducing youth to career options and giving youth the skills and opportunity to lead and provide service to their communities. Metrics: • 90% of 4-Hers that complete record books document they complete at least 1 community service project each year. • 4-Hers averaged 53 hours of community service as documented in 2020 record books. • 380 4-Hers participated in Leadership, Public Speaking or Career readiness programs. • 100% of 4-Hers reported on surveys that they learned something new in science, health, or life skills at our workshops that they will use in school or at home. • 79% of 4-Hers indicated they increased interest in learning new things as a result of the 4-H programs. • 93% of 4-Hers report they will use the information they learned at RI 4-H programs in 2020 when they make decisions in the future. • 495 of youth enrolled or registered for science, personal development and healthy lifestyles projects and events. • 72% of 4-Hers report they increased their life skills and academic competencies through the 4-H Program. 4-H educational engagement measured by websites and social media: • 23,257 pageviews of the 4-H website, indicating interest or engagement in 4-H programs. • 307 page views of the new 4-H homeschooling web resources in 1 month (September 2020) for families to access educational resources. • 31,534 reached through Facebook • 4,665 engagements through Facebook • 956 interactions through Instagram • 1199 RI 4-H YouTube Channel views For more information, please see https://web.uri.edu/4h/ and https://web.uri.edu/4h/distance-learning-homeschooling/	

OPTIONAL **Youth Development Expenditures (dollars)**	
State and/or Institution:	FY 2020 Expenditures ($)
1862 Smith-Lever	$149,658.67
1890 Extension	